MONTANA FISH AND GAME DEPARTMENT
FISHERIES DIVISION
HELENA, MONTANA

OBSERVATIONS ON THE LIFE HISTORY AND MOVEMENT OF CUTTHROAT TROUT (*SALMO CLARKI*) IN FLATHEAD RIVER DRAINAGE, MONTANA

COMPLETION REPORT FOR JOB III, PROJECT NO. F-7-R-10

A FEDERAL AID TO FISH RESTORATION PROJECT

(Prepared as a thesis in partial fulfillment of the requirements for the degree of Master of Science in Fish and Wildlife Management at Montana State College)

by

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June, 1961

Contents

Abstract

Observations on the life history and movement of cutthroat trout (Salmo clarki) in the upper Flathead River drainage were made during the summer of 1959 and the spring and summer of 1960. Spawners were found from April through June. Resident spawners, 6.3 to 10.1 inches total length and migrant spawners, 12.0 to 19.3 inches, were found in the small tributary streams. The average number of eggs produced by females ranging from 12.0 to 15.9 inches total length was 1482. Spawning in the inlet stream of Mud Lake was observed from April 21 to June 1, 1960, where the upstream migration of spawners was apparently stimulated by increased stream flows. Cutthroat trout embryos eyed in 38 to 49 days, hatched in 50 to 60 days and emerged from the gravel in 77 days. Cutthroat trout fry and fingerling were found almost exclusively in the smaller tributary streams throughout the drainage. Most fry emerged in July. The age and growth rates for 766 cutthroat trout collected in the Flathead River drainage was determined and averaged separately for fish taken in rivers, in lakes, and in tributaries. The average calculated length at each annulus for 569 river fish (Age Groups 1-6) was as follows: 2.2, 4.7, 7.7, 11.3, 13.1, and 14.9 respectively. Tag returns were received for 13 of a total of 175 cutthroat trout tagged in the Flathead River drainage. Eight of these showed downstream movement of 10 to 40 miles, while five showed no movement.

Introduction

The cutthroat trout (Salmo clarki) was at one time abundant in most of the waters of the Rocky Mountain area in Montana. The upper Flathead River drainage in the northwestern part of the state provides one of the few remaining cutthroat trout fisheries. Efforts are being made to maintain this native trout fishery. The present study on the life history and movement of this species was conducted in the summer of 1959 and the spring and summer of 1960 mainly on the North Fork of the Flathead River, but observations and collections were also made at other locations in the drainage.

The cutthroat trout has been studied in Montana by several workers. Echo (1956) investigated it in relation to yellow perch. Block (1955) reported on the migration and spawning of cutthroat trout in the North Fork of the Flathead River and Hanzel (1960) described the distribution of this species in Montana. Studies on the life history of the cutthroat trout in other locations are as follows: Fleener (1952) in Utah, Irving (1956) and Bjornn (1961) in Idaho, Smith (1941; 1947) and DeWitt (1954) in California, Cramer (1940) in Oregon, Neave (1949) in British Columbia, and Cope (1956) in Yellowstone Park, Wyoming.

The Study Area

The upper Flathead River drainage which is mainly in Flathead County and Glacier National Park consists of the main Flathead River, three major tributary streams (the North, South, and Middle Forks), and numerous small tributaries (Fig. 1). The three major Forks arise along the western slopes

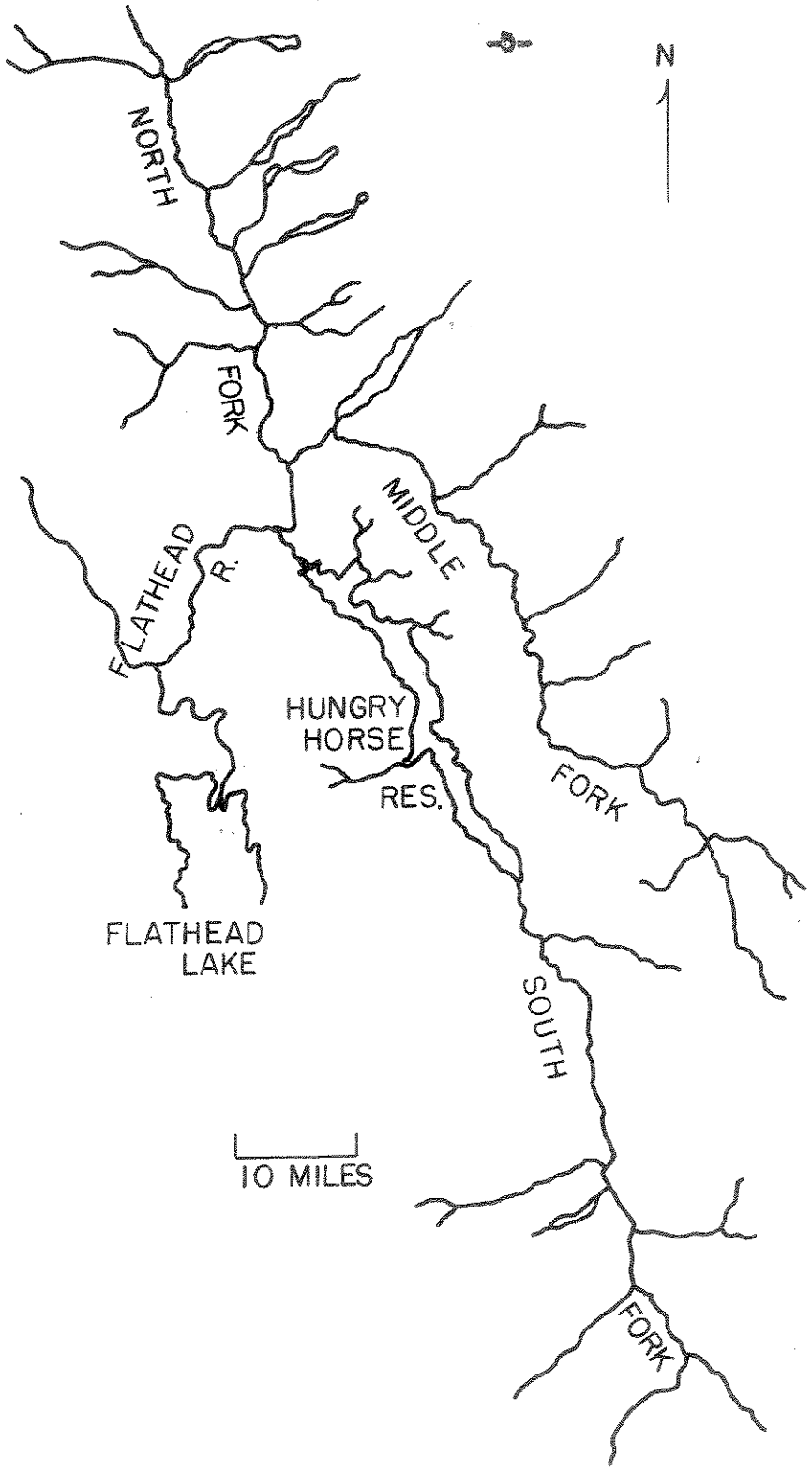

Fig. 1. Flathead River drainage.

of the Continental Divide at elevations of 8,000 to 10,000 feet. The drainage area is characterized by steep slopes covered by dense coniferous forests. The main Flathead River flows south in a broad agricultural valley for 90 miles where it empties into the north end of Flathead Lake. A major change in the drainage character was brought about by the construction of Hungry Horse Dam athwart the South Fork River in 1953. The dam creating a reservoir 34 miles long with an estimated surface area of 29,000 acres effectively blocks fish movement.

The cutthroat trout is distributed throughout the entire Flathead drainage above Flathead Lake. Manzel (1960) reported it in 95 of the 98 streams and lakes investigated. Native associated species are bolly varden (Salvelinus malma), mountain whitefish (Prosopium williamsoni), Cottus sp., peamouth (Mylocheilus caurinus), longnose sucker (Catostomus catostomus), largescale sucker (Catostomus macrocheilus), redside shiner (Richardsonius balteatus), and northern squawfish (Ptychocheilus oregonensis). The cyprinids and suckers are more abundant in the lower Flathead River while the others are predominant in the upper drainage. Fish planting into the drainage began as early as 1910 in the vicinity of Glacier Park and has continued to the present time for some species. Rainbow trout (Salmo gairdneri) were introduced at various locations until 1950. Since that time stocking has been restricted in order not to further contaminate the native cutthroat trout population. During this study only four rainbow trout were encountered and all were from the main Flathead River near Flathead Lake. A few specimens showed some characteristics of rainbow-cutthroat hybrids (Manzel, 1960), but no attempt was made to separate these

from cutthroat trout. Since 1915, cutthroat trout from Yellowstone Lake, Wyoming or progeny of this stock, have been planted throughout the drainage, especially within Glacier Park and nearby waters. The extent to which this fish has established itself or hybridized with the native cutthroat trout population is not known. Brook trout (Salvelinus fontinalis) and arctic grayling (Thymallus arcticus), stocked at various locations in the drainage, are seldom taken in the river system. Kokanee (Oncorhynchus nerka) and lake whitefish (Coregonus clupeaformis) are present in the river, having found access from Flathead Lake. The kokanee is only abundant in the river during its spawning season. Various warmwater species introduced to Flathead Lake are occasionally taken in the lower river.

Specimens upon which this study is based were collected by electrofishing, stream traps, minnow seines, angling, and with cresol. Data were also obtained from fish taken by anglers contacted along the streams. Fish were measured to the nearest 0.1 inch total length and weighed to the nearest 0.01 pound. Scale samples were taken from each. Tags used in this study were plastic, bird leg bands which were attached to the lower jaw.

The writer extends thanks to those individuals and agencies who assisted with this study. Dr. C. J. D. Brown directed the investigation and assisted in the preparation of the manuscript. Jerold F. Rahrer, student assistant, and Delano A. Hanzel and Boyd R. Opheim of the Montana Fish and Game Department gave valuable assistance with the field work.

Glacier National Park officials were helpful in granting permission to make collections within the Park and in making their records available. The Montana State Fish and Game Department provided financial support through Dingle-Johnson project number F-7-R.

Spawning

Observations were made on certain tributaries of the Flathead River during the spring and early summer in order to locate spawning cutthroat trout and to determine the spawning period. A few observations were also made on the North Fork River and the main Flathead River. Although high water conditions prevented efficient sampling, some collections were made with either cresol, an electric shocker, or by angling. Fishermen creels were checked at every opportunity to determine the sexual maturity of fish in the catch. Fish sexually developed for spawning in the current season were classified as: "green" if milt or eggs were not extruded when pressure was applied; "ripe" if sex products were extruded when pressure was applied; "spent" if spawning was complete. The sex of cutthroat trout spawners was distinguished either by examination of the gonads or sexual products or by external characteristics of body color and form. The latter was proven reliable in all spawners in which the gonads or sex products were examined.

Collections were made from Red Meadow Creek and Langford Creek in the North Fork River drainage; Deep Creek, Murray Creek, and Riverside Creek, tributaries of Hungry Horse Reservoir; the Stillwater River which enters the main Flathead River near Flathead Lake. Observations began on June 16,

1959 and all spawners were found from this date through June 24 except for three ripe males taken August 23. In 1960 observations began on March 26 and spawners were found from April 25 to June 29 except for two ripe males taken August 22. During both years a total of 16 males and 33 females was captured. All males were ripe. Twenty-six of the females were green, five were ripe, and two were spent. All ripe and spent females were taken after June 9 in both years except one spent female taken in the North Fork River on May 28, 1960.

The spawning period of cutthroat trout in the tributary streams probably reaches its peak in mid-June. Block (1955) observed cutthroat trout spawning in two tributaries of the North Fork River on June 17 and 19 and found that those taken by fishermen after early July had completed spawning.

Observations during the spawning period indicated that both resident and migratory populations of cutthroat trout exist in the Flathead River drainage. Small cutthroat trout, four to ten inches in length, were abundant in many of the tributary streams during the entire study period. Undoubtedly many of these fish are mature residents of the streams during the entire year. Evidence of spawning by resident trout in one of these streams (Langford Creek) was found during observations in 1960. A trap designed to catch upstream migrants was placed near the mouth of Langford Creek in April and maintained until June. No migrant fish were taken; however, spawners which ranged from 6.3 to 10.1 inches in total length were collected above the trap during the same period. On the other hand, large cutthroat trout, 12.0 to 19.3 inches in total length, were found in

some streams only during the spawning period. These larger fish were usually found in the lower reaches of the tributaries and evidently move out of the larger streams for spawning.

The spawning activity of cutthroat trout in Mud Lake (Langford Creek drainage) was observed in an inlet stream from April 21 to June 1, 1960. This inlet was supplied by several small springs and melting snow. It had a flow of less than one cfs on April 21. Heavy rains increased the stream volume to three cfs on May 2 and to approximately five cfs (maximum) on May 12 and 13. The temperature of the springs ranged from 40 to 45 F, but melting snow held the stream temperature at 39 F or less throughout the spawning period. A trap designed to catch upstream migrants from the lake was placed near the mouth of the inlet on April 21, seven days before ice cover disappeared from the lake. The trap was maintained in the stream until June 2, except for May 14 and 15 when it was partially washed out. Each captured fish was weighed, measured, and marked with a colored plastic tag. All fish were placed above the trap after tagging.

Five green males and one green female entered the trap on May 3. Movement into the stream was apparently stimulated by the increased flow. The peak of the spawning run occurred on May 12 and 13 while the trap was washed out. More than 40 fish were observed above the trap on May 14 and only four of these were known to have tags. The last fish entered the trap on May 28. A total of 13 females and 23 males was trapped. The average total length and weight for females was 12.5 inches and 0.86 pounds and for males 11.0 inches and 0.46 pounds respectively. Spawning was first observed on May 13. Paired fish occupied nearly every part of

the inlet stream where depths were over three inches. They were especially concentrated in the vicinity of the springs. Considerable overlapping of redds occurred at the mouth of the springs where as many as six pairs spawned in an area of less than four square feet. Some areas which appeared suitable for spawning were not utilized. These same areas were dry later in the season. Spawners moved downstream immediately following spawning and no adult trout were observed in the stream after June 1. Spawning in this lake is apparently limited to the period of spring runoff because the shallow nature of the inlet stream does not permit access at any other time.

Fecundity

The fecundity of 18 "green" female cutthroat trout with an average length of 14.6 inches and an average weight of 1.01 pounds was determined by actual egg counts (Table I). Fourteen specimens were taken by fishermen and four were collected by electrofishing.

The largest number of eggs (1874) was produced by a fish 15.5 inches in total length and the smallest number (877) by a specimen 13.3 inches in total length. This does not include one very small specimen (6.3 inches total length) which produced only 183 eggs. The average number of eggs produced by fish in each length group was as follows: 13 to 14 inches, 1236 eggs; 14 to 15 inches, 1548 eggs; and 15 to 16 inches, 1625 eggs. The average number of eggs produced by all females was 1482. This value is slightly less than that reported by Irving (1953) for cutthroat trout of the same size from Idaho and slightly more than Cramer (1940) reported

Table I. Size and number of eggs for 18 cutthroat trout collected in the Flathead River drainage.

Stream	Total length (inches)	Weight (pounds)	Number of eggs
Stillwater River	15.9	1.39	1704
	15.9	1.27	1307
	15.8	1.25	1589
	15.8	1.14	1637
	15.6	1.28	1617
	15.5	1.26	1644
	15.5	1.18	1674
	14.9	0.98	1667
	14.6	0.88	1561
	14.4	0.92	1858
	14.2	0.80	1191
	14.1	0.83	1190
	14.0	0.86	1465
Flathead River	13.9	0.94	1428
Stillwater River	13.8	0.76	1357
Deep Creek	13.5	0.86	1091
	13.3	0.92	867
Murray Creek	12.0	0.70	1176
Average	14.6	1.02	1482

for sea-run cutthroat trout in Oregon.

Early Development

The rate of development and incubation period were determined from a study of four redds in the inlet stream of Mud Lake where actual egg deposition was observed. Spawning in the four redds was complete by May 14. Redds were located in the inlet stream where velocities were moderate and depth ranged from 3 to 14 inches. Eggs were found at depths of two to five inches below the substrate which consisted of small gravel and sand. Each redd was marked and examined frequently during the post spawning period to assure it was not disturbed. Samples were taken from each redd at approxi-

mately ten day intervals. Eyed eggs were first taken on June 29, 46 days after spawning. Both eyed eggs and recently hatched fry were found in each redd on July 14, 60 days after spawning. The fry had an average length of 17 mm and showed strong negative reactions to light and current by reburying themselves in the gravel. Fry which had recently emerged from the gravel were first observed on July 29, 77 days after spawning. These had an average length of 23 mm. Water temperatures ranged from 35 to 39 F during the first 57 days of the development period and then gradually increased to a maximum of 50 F on July 29.

Information on development was also obtained by taking spawn from two females and two males caught in the trap. The fertilized eggs were enclosed in screened boxes and were then placed in the stream away from currents and direct sunlight. One box was placed in the inlet stream on May 16 and one in a nearby spring on May 23. Heavy mortality of embryos in both boxes resulted from an accumulation of fine sediments, however a few survived. Eggs placed in the stream proper were eyed 49 days after fertilization but none hatched. Those placed in the spring were eyed in 38 days and hatched about 50 days after fertilization. Fry still had large yolk sacs but showed strong swimming movements 57 days after fertilization. These fry were free-swimming in 81 days and had entirely absorbed their yolk sacs. They averaged 26 mm in length 89 days after fertilization. Water temperatures in the stream ranged from 35 to 39 F during the first 57 days and then gradually increased to a maximum of 53 F on the last day of observations. Water temperatures in the spring ranged from 41 to 47 F.

Fry and Fingerling

Cutthroat trout fry and fingerling were taken in some tributaries of the North Fork River during both seasons (Tables II and III). Streams

Table II. Relation of stream size to numbers of cutthroat trout and other fish species taken by shocking in the North Fork River drainage.

Stream	Date	Stream volume(cfs)	Number of cutthroat trout	Size range	Number of other species
Langford Creek	7-2-59	3	32	2.4-5.2	0
Cyclone Creek	7-8-60	11	28	2.8-6.6	0
Skookoleel Creek	7-9-60	31	22	4.7-7.9	0
Logging Creek	7-6-60	173	7	3.8-6.6	2
Coal Creek	7-8-60	191	0	- - - -	12
Camas Creek	7-6-60	243	0	- - - -	19
Big Creek	7-9-60	258	0	- - - -	12

Table III. Size of fry collected in the North Fork River drainage during 1959 and 1960 (Total length in millimeters).

Stream	Date	Range	Average	Number
Langford Creek	7-12-59	33-39	36	4
	7-15-59	21-29	25	44
	7-16-59	21-31	27	30
	7-17-59	25-30	27	10
	8-10-59	24-46	36	23
	8-26-59	21-46	38	10
Moran Creek	8-10-59	21-28	24	20
Logging Creek	7-21-60	21-42	31	20
Cyclone Creek	8-11-59	33-38	47	14
	7-21-60	21-42	31	16
North Fork River	7-20-60	37-41	38	3

ranging from less than 1 cfs to 258 cfs were sampled. Cutthroat trout fry and fingerling were found almost exclusively in the smaller streams, while fingerling dolly varden and whitefish were usually taken in the larger ones. DeWitt (1954) also reported coastal cutthroat trout, "fish of the

year", were found only in the very smallest tributaries. Block (1955) reported an absence of young of the year cutthroat trout except in a few small streams, although he experienced no difficulty finding dolly varden fingerling in most streams. The paucity of young cutthroat trout in the larger tributaries may result from poor spawning success or inadequacy of sampling. Extremely high water conditions in the larger streams cause severe scouring of the stream channels during spring run-off and may result in poor spawning success. On the other hand stream flow conditions are more favorable to successful reproduction in the fall when whitefish and dolly varden are spawning. More moderate flows in streams with relatively small drainage areas may contribute to higher spawning success. Three of the streams (Logging Creek, Langford Creek, and Cyclone Creek) with abundant cutthroat trout fry have lakes at their headwaters which tend to moderate stream flows and temperatures during the spring run-off period.

Fry which had recently emerged from the gravel averaged 28 mm in total length and were first found on July 15. The yolk sac was not completely absorbed on some individuals but many of the others appeared to be feeding actively in the shallow pools and along the stream edges. Fry collected later in the season (August) showed a wide range in size and development. This indicates that emergence from the gravel extends over much of the summer period. Fry did not appear until August 10 in Moran Creek. These averaged 24 mm in total length and a few still had the yolk sac present.

There was no evidence of extensive movement of fry from the tributary streams, however, observations indicated some fingerling move to the large

streams in their second or third year of life. In Langford Creek many fingerling of previous years hatch (2.0 to 4.0 inches total length) were found concentrated in the pool areas in April, but had decreased in number by September. Young of the year occupied these same pool areas in late August and September. A trap designed to catch fry moving downstream was placed in Langford Creek during June and maintained through August. The trap did not cover the entire stream width but most fry drifting downstream would have been captured. Only one fry was taken, but 22 fingerling (2.1 to 4.1 inches in total length) were captured during the period.

Near the mouth of Deep Creek an estimated 70 to 100 cutthroat trout, three to eight inches in length, were found in a pool created by a vertical road culvert. The majority of these fish had moved downstream during the highwater period and were prevented from continuing their descent to the river after the water level dropped around the culvert standpipe. Eight of the larger of these fish, taken by angling, were two to three years old. Since the culvert is a barrier to upstream migration from the river, all of these fish were progeny of resident spawners. It is the writer's opinion that large numbers of young cutthroat trout are recruited to the river population from resident trout reproduction in the small tributaries. The apparent high survival rate to the fingerling stage in these streams probably induces some of the population to move downstream.

Many attempts were made to find cutthroat trout fry in the North Fork River. Samples were made with a minnow seine in various habitats during both seasons. Although whitefish fingerling were taken often, cutthroat

trout were captured only once. These averaged 38 mm total length and were captured on July 20 more than two miles from the nearest tributary stream. Cutthroat trout (3 to 8 inches in total length) were abundant in the North Fork River during the summer period and were frequently observed in schools in the deep pool areas of the stream.

Movement

Some observations on the movement of cutthroat trout within the Flathead River drainage were made in conjunction with life history observations during 1959 and 1960. A total of 175 cutthroat trout were captured by angling and marked with individually numbered jaw tags. Of these, 108 were marked in the North Fork River, 23 in tributaries of the North Fork River, and four in the upper six miles of the main Flathead River. Only fish six inches in total length or larger were marked because of the size of tags available.

Information on the movement of trout was obtained from 12 tag returns by fishermen and one by the tagging crew (Table IV). Eight of the fish tagged in the North Fork River were caught 10 to 40 miles downstream from points of release. Four tagged fish were caught in the North Fork River and one in Big Creek at the same location as they were released. None of the tag returns showed upstream movement.

The few tag returns suggest a trend for some fish 7 to 11 inches in length to move downstream. Block (1955) reported that cutthroat trout in the North Fork River follow a migratory behavior pattern, leaving the North Fork River in late summer and fall, although he did not have tag

Table IV. Cutthroat trout tag returns and distances in miles traveled downstream in the Flathead River drainage during 1959 and 1960.

Total length	Date tagged	Tagging location	Date recaptured	Location caught	Distance moved
8.4	9-7-59	North Fork River	7-18-60	Flathead River	40
8.1	7-28-60		8-9-60		25
7.4	7-28-60		8-30-60		24
7.9	8-18-60		10-3-60		29
9.1	8-18-60		9-11-60		13
10.3	9-7-59	North Fork River	7-26-60	North Fork River	none
9.3	9-11-59		8-29-60		none
8.0	7-19-60		7-20-60		none
7.5	7-27-60		8-12-60		15
8.8	7-27-60		8-12-60		10
7.9	8-17-60		8-29-60		none
10.9	8-18-60		10-3-60		25
10.9	8-19-60	Big Creek	9-14-60	Big Creek	none

returns to substantiate this. The writer's observations including tag returns from the same point of release, indicate that some cutthroat trout probably remain in the North Fork River the entire year.

Age and Growth

Scales were collected from 766 cutthroat trout in the Flathead River drainage during 1959 and 1960. Scales were taken from the left side of the fish between the lateral line and the dorsal fin. Scale impressions were made on plastic and increments between annuli were measured along the median-anterior radius of the magnified scale. Lengths at each annuli were determined with the aid of a nomograph. A constant ratio of scale radius to body length was assumed.

Cutthroat trout scale samples included: 106 from small tributary

streams of the North Fork River drainage; 101 from lakes in the North and South Fork River drainages; and 559 from the rivers (North, South, and Middle Fork Rivers and the main Flathead River). Because of apparent differences in growth rates, data for each group are presented separately.

Fish in the tributary streams (Table V) grew at the slowest rate.

Table V. Average calculated total lengths and increments for cutthroat trout collected in tributary streams in 1959 and 1960.

Age group	Number of fish	Length at capture	Year of Life 1	2	3	4	5	6
I	20	4.6	2.7					
II	59	5.6	2.3	4.4				
III	19	7.9	2.3	4.8	7.0			
IV	4	10.7	2.3	4.7	7.2	9.2		
V	2	10.9	2.5	3.8	5.5	6.7	8.9	
VI	2	13.5	2.2	3.5	6.0	8.8	10.4	12.0
Grand averages			2.3	4.5	7.0	8.5	9.6	11.9
Increments			2.3	2.2	2.5	1.5	1.1	2.3
Number of fish	106		106	86	27	8	4	2

The rate of growth during each of the first three years was relatively equal, after which it declined. The pattern of scale growth in these fish was characterized by closely packed circuli within each annulus and many of the scales from the older fish were badly eroded on the edges. Most of the fish in the tributary streams were in Age Group I and II. The average calculated length of tributary fish at the fourth annulus was 2.8 and 2.6 inches less than those of the same age from the rivers and lakes respectively.

Fish taken in the rivers (Table VI) showed a rapid increase in growth during their third and fourth years of life, after which their growth rate

Table VI. Average calculated total lengths and increments for cutthroat trout collected in rivers in 1959 and 1960.

Age group	Number of fish	Length at capture	Year of life 1	2	3	4	5	6
I	51	5.6	2.9					
II	241	7.9	2.3	5.1				
III	180	9.9	2.1	4.4	7.5			
IV	65	13.5	2.3	4.7	8.2	11.5		
V	18	13.9	2.0	4.0	7.2	10.4	13.1	
VI	4	15.1	1.6	3.4	6.7	10.0	12.8	14.9
Grand averages			2.2	4.7	7.7	11.3	13.1	14.9
Increments			2.2	2.5	3.0	3.6	1.8	1.8
Number of fish	559		559	508	267	87	22	4

declined. The majority of fish taken in the rivers were in Age Groups II and III. The pattern of scale growth for river fish resembled that of tributary fish for the first two or three years of life, but were characterized by widely spaced circuli after the second or third annuli. This pattern of growth would be expected if cutthroat trout spend their first two or three years of life in the tributary streams before entering the river. Bjornn (1961) found similar growth patterns for cutthroat trout which spent two to four years in the tributary streams before entering Priest Lake.

Cutthroat trout collected in the lakes (Table 7) grew most rapidly during their first three years after which their yearly increments declined. The average calculated length of lake fish was considerably larger than river fish for the second and third years, but these two groups were of almost equal average lengths at the end of their fourth year. The pattern of scale growth in the lake fish showed widely spaced circuli beyond the first annulus.

Table VII. Average calculated total lengths and increments for cutthroat trout collected in lakes in 1959 and 1960.

Age group	Number of fish	Length at capture	Year of life 1	2	3	4	5	6
I	6	3.9	3.2					
II	23	8.4	2.7	5.9				
III	48	10.2	2.6	5.2	9.2			
IV	21	10.6	2.1	4.8	9.1	11.3		
V	3	12.1	2.0	4.4	6.6	9.9	11.7	
VI								
Grand average			2.5	5.2	8.9	11.1	11.7	
Increment			2.5	2.7	3.7	2.2	0.6	
Number of fish	101		101	95	72	24	3	

The average calculated growth rates for cutthroat trout in the Flathead River drainage are generally slower than those reported for cutthroat trout in Logan River, Utah by Fleener (1952) and in the West Gallatin River, Montana by Purkett (1951). The growth rates reported for cutthroat trout in Yellowstone Lake, Wyoming by Willoughby (1951) and Henrys Lake, Idaho by Irving (1956) were considerably greater than those in the Flathead River drainage. The growth rates given for coastal cutthroat trout during their stream life, DeWitt (1954) are comparable to those in the Flathead River drainage.

A total of 38 cutthroat trout spawners collected in the Flathead River and its tributaries had the following age compositions: Age III-3%; Age IV-60%; Age V-24%; Age VI-13%. Cutthroat trout in Mud Lake apparently mature sooner than those in the river. Age Groups II and III made up 21% and 76% respectively of the spawners collected in the inlet stream trap on this lake in April.

The time of annulus formation varies within the drainage. Most fish collected after June 1, regardless of location, had one or more completed

circuli of new growth on their scales, however, scales from some fish collected in the lower Flathead River had newly completed circuli as early as May 24. A few fish collected in tributary streams as late as July 4 still had no new growth beyond the last annulus mark. The latest collection of either season was taken in the North Fork River on September 14, 1959. The scales in this collection did not show any evidence of reduced summer growth. However collections from the Middle Fork River and Two Chuck Creek in late August did show closely packed, incomplete, circuli on the scale edges indicating the end of the growing season. These collections were made at relatively high elevations where the growing season is short.

Summary

1. Observations on the life history and movement of cutthroat trout in the Flathead River drainage above Flathead Lake were made during the summer of 1959 and the spring and summer of 1960.

2. Spawners were found from April through June with most ripe or spent females being taken after June 9. Spawning probably reaches its peak by mid-June.

3. Both resident spawners (6.3 to 10.1 inches total length) and migrant spawners (12.0 to 19.3 inches) were found in the small tributary streams. Migrant spawners remained in the small tributaries only during the spawning season.

4. Spawning activity in the inlet stream of Mud Lake was observed from April 21 to June 1, 1960. The upstream migration was apparently

stimulated by increased stream flow. Actual spawning lasted from May 13 to June 1 (water temperatures ranged from 35 to 39 F).

5. Embryo development was studied in four redds and in two screened boxes placed in the stream. These eyed in 38 to 49 days, hatched in 50 to 60 days, and emerged from the gravel in 77 days.

6. Cutthroat trout fry and fingerling were found almost exclusively in the smaller tributary streams. Most fry emerged from the gravel in July. There was some evidence that fry remain in the spawning streams for one or two years and then move to the larger streams.

7. The average number of eggs produced by females in each length group was as follows: 13 to 14 inches, 1236 eggs; 14 to 15 inches, 1548 eggs; 15 to 16 inches, 1625 eggs.

8. Tag returns were received for 13 of 175 tagged cutthroat trout in the North Fork River. Eight of these showed downstream movement ranging from 10 to 40 miles. Five showed no movement.

9. The age and growth rated for 766 cutthroat trout was determined and averaged separately for fish taken in tributary streams in lakes and in rivers. The average calculated lengths at each annulus for 559 river fish were as follows: (Age Groups 1-6), 2.2, 4.7, 7.7, 11.3, 13.1, and 14.9 respectively.

10. Most fish showed new growth beyond the last annulus by June 1.

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